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Analysis of soil texture and water soluble salt content in high standard farmland construction in Fengxiang area

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Abstract

In order to ensure the grain production and food security in our country, improve the farmland grade, improve farmers' income, and realize the cultivation of grain in the ground and the cultivation of grain in technology. While promoting the national and Shaanxi Province to issue high-standard farmland construction project planning tasks, through the measurement of soil texture, salt content, acid and alkalinity in Fengxiang District to be built high-standard farmland area, it is pointed out that the soil texture type in the study area is mostly silt, and the average water-soluble salt content of soil is 0.8371%, lower than the standard of non-saline soil. The pH value of the soil ranges from 8.21 to 8.29, and the acid-base grade is alkaline. In summary, through proper alkali modification, the newly built high-standard farmland can meet the demand for soil texture of food crop growth and meet the requirements of high-standard farmland construction in Northwest China.

Keywords

High-standard farmland; Soil particle composition; Soil water-soluble salt content; Soil pH.

1. Introduction

Cultivated land is the "lifeblood" of grain, and the coordinated development of quantity and quality is related to China's food security and social stability [1]. High-standard farmland construction is a key measure to consolidate and improve grain production capacity and ensure national food security [2]. The construction of high-standard farmland has appeared in the central No. 1 document for more than 10 consecutive years. As early as 2005, some major grant-producing provinces in Sichuan carried out the "fertile soil project". In 2014, the Central No. 1 document proposed the implementation of the national master plan for high-standard farmland construction. In 2016, the Central No. 1 document proposed to promote the construction of high-standard farmland on a large scale. On November 21, 2019, The General Office of the State Council issued the Opinions on Effectively Strengthening the Construction of High-Standard Farmland to Enhance the National Food Security Capability, proposing that by 2022, the country should build 1 billion mu of high-standard farmland, and the construction of high-standard farmland will be included in the assessment content of the cultivated land protection

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responsibility of local governments at all levels. On November 2, 2021, The State Council approved the "National High-Standard Farmland Construction Plan (2021-2030)" (hereinafter referred to as the "Plan") by the "State Letter (No. 202186)". The "Plan" focuses on the grain production target, defines the overall requirements, construction standards and construction content, construction zones and construction tasks, construction supervision and follow-up management and protection, benefit analysis, implementation guarantee, etc., and provides an important basis for the scientific and orderly development of high-standard farmland in various regions.

On February 24, 2022, the Ministry of Agriculture and Rural Affairs issued a notice on the task of farmland construction in 2022, requiring the national plan to build 100 million mu of high-standard farmland and coordinate the development of 15 million mu of efficient water-saving irrigation in 2022, of which 3 million mu of high-standard farmland and 700,000 mu of efficient water-saving irrigation area in Shaanxi Province [3]. On November 14, 2022, the General Office of the Shaanxi Provincial People's Government issued a notice of action plan to accelerate the construction of high-standard farmland, which pointed out that by 2025, the province will build 21.94 million mu of high-standard farmland, upgrade 1.14 million mu, and achieve full coverage of major grain-producing counties. The planned task of the 3 million mu farmland construction project in Fengxiang District in 2022 is 83,000 mu [4]. According to statistics, in 2021, the grain sown area of Fengxiang District will be 832,000 mu, among which the wheat sown area will be 627,500 mu and the corn sown area will be 179,900 mu, and the wheat and corn sown area will account for 96.94% of the total grain sown area of Fengxiang District. Total grain production was 290,000 tons, an increase of 2.4% over the previous year [5]. Fengxiang area has a good grain planting foundation. Therefore, it is necessary to find out the soil texture, salt status, acid-base degree and nutrient benefit of the high-standard farmland area to be built in this area, so as to provide a scientific basis for the smooth construction of high-standard farmland, and improve the quality of cultivated land and grain production capacity through targeted suggestions and measures.

2. Materials and methods

2.1. Overview of the study area

Fengxiang District, located in Baoji City, Shaanxi Province, is located in the west of Guanzhong Plain, the northeast of Baoji City, the city is 44 km away from the central city of Baoji. The east and west of Fengxiang District are Qishan County and Qianyang County respectively, and the north and south are Chencang District and Linyou County respectively. The area is 1179 km2. Fengxiang is located in the compound position of Qinling latitudinal, Qilu He Mountain font and Shaanxi spiral structural system. The topography is complex and diverse, including mountains, rivers, terraces, gullies and gullies. In the north, the low mountain hills and hilly gully areas have undulating mountains, gullies and ravines, the main gully system is open, the slope is gentle, mostly in 15 ~ 20 degrees, and the natural vegetation is superior to the highland area. The southern Sichuan Highland is flat with an elevation of 750 ~ 950 m and fertile soil. Fengxiang District is a warm temperate continental monsoon climate area, semi-humid and semi-arid. The average annual temperature is 11.4 degrees, and the precipitation is 790 mm. The rainfall is mainly concentrated in July, August and September, and the frost-free period is 209 days. The main aquifers of groundwater are sand, gravel and stone layers. The thickness of the water layer is 18.6 ~ 26.38 m, which gradually becomes thinner from south to north. Shallow water and shallow confined water are mined. The depth of water level in the burial zone is 20 ~ 40 m, and the water salinity is less than 1 g/L. There are four distinct seasons throughout the year, winter and summer are long and spring and autumn are short, and rain and heat are in the same season, which is conducive to crop growth. However, in the growing

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season of crops, the solar radiation is strong, the temperature and precipitation vary greatly from year to year, and drought is easy to occur.

2.2. Experimental design

In order to better implement the task of high-standard farmland construction, combined with the high-standard farmland construction plan of Shaanxi Province in 2022, Determine the implementation of high standard farmland in 10 villages in Liulin Town, Chencun Town and Changqing Town: Beidoufang Village (BDF), Caiyangshan Village (CYS), Dongwutou Village (DWT), Yidi Village (LD), Luobasi Village (LBS), Pangjiji Village (PJW), Shangying Village (SY), Shitou Village (STP), Xijie Village (XJ) and Zijing Village (ZJ) Construction of general exploration, a total of 28,300 mu. Five surface soil samples (0 ~ 20 cm) were randomly collected from wheat fields in each village, and the measured results were averaged.

The soil particle size composition was determined by the Malvern Laser particle size analyzer Mastersizer 3000 (UK), and the particle size was graded according to the American Department of Agriculture standard [6]. The total amount of water-soluble salt in soil was dried by hydrogen peroxide. Soil pH was measured directly by pH meter.

Using DPS 7.05 software, Duncan's new complex range method was used for statistical analysis of the data.

3. Results and analysis

Table 1 shows the soil texture of the proposed high-standard farmland plot in Fengxiang area. As can be seen from Table 1, the soil texture types of the high-standard farmland construction areas designated in Fengxiang are mostly silt, among which, the soil texture of the farmland in Shangying Village is silt, that of Shitopo village is loam, and that of Zijing village is silt. The sand content of the soil in the study area is generally high, and the clay content is low. The sand content of the soil in the study area ranges from 68.66% to 83.11%, and the average content is 74.41%. The soil silt content ranged from 3.41% to 19.98%, and the average content was 13.75%. The soil clay content ranged from 10.86% to 13.48%, and the average content was 11.75%. The sand content of Shitopo village was the highest, which was 21.05% higher than that of Yudi village. The powder content of Yidi village was the highest, which was relatively higher than that of Shitopo village (486.59%). The clay content of Shitopo village was the highest, which was relatively higher than that of Caiyangshan Village (26.58%). At the level of Duncan's new complex range method ($P<0.05$), the sand content of Yidi village and Shitopo village reached a significant difference, while the other villages had no significant difference in sand content. At the level of Duncan's new complex range method ($P<0.05$), the soil sand content of Yidi village, Pangjijia Village and Shitopo village reached significant difference, while the difference of soil sand content in other villages was not significant. At the level of Duncan's new complex range method ($P<0.05$), soil clay content in all villages was not significant.

Table1 Soil mechanical composition and texture of areas to be built with high standard farmland in Fengxiang

Village	Granulometric composition/%			Texture
	Sand (2～0.05mm)	Silt (0.05～0.002mm)	Clay(<0.002mm)	
BDF	75.06±1.4573b	13.28±1.6298bcd	11.66±1.4812a	Silt loam
CYS	76.06±1.7496b	12.29±1.9870d	11.65±1.0388a	Silt loam
DWT	73.79±2.7475bc	14.37±0.8916bcd	11.84±1.2438a	Silt loam

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LD	68.66±3.2629c	19.98±1.4655a	11.36±0.7176a	Silt loam
LBS	72.12±3.4104bc	15.79±0.8844bcd	12.09±1.8207a	Silt loam
PJW	74.77±2.6402b	12.84±1.2319cd	12.39±0.9784a	Silt loam
SY	72.17±3.3186bc	16.47±3.7332abc	11.36±1.5803a	Silt clay loam
STP	83.11±1.5309a	3.41±0.7635e	13.48±0.9893a	Loam
XJ	76.30±1.2709b	11.98±1.1618d	11.72±1.0316a	Silt loam
ZJ	72.05±2.6304bc	17.09±0.7832ab	10.86±1.9322a	Silt

Note: The different Lowercase letters are significant differences at the 0.05 level of Duncan. The same as below.

Table 2 shows the water soluble salt content of soil in the proposed high-standard farmland plot in Fengxiang area. As can be seen from Table 2, the total amount of water-soluble salt in soil in the study area ranges from 0.7164 g/kg to 0.9169 g/kg, with an average content of 0.8371%, among which the total amount of water-soluble salt in soil in Beidoufang Village is the highest, and that in Zijing Village is the lowest, which is relatively lower by 21.87%. The total water soluble salt in soil of Beidoufang village, Yidi village and Zijing Village reached significant difference at Duncan's new complex range method ($P<0.05$) level.

Table 2 Soil total water soluble salt of areas to be built with high standard farmland in Fengxiang

Village	Total water soluble salt(g/kg)	Village	Total water soluble salt(g/kg)
BDF	0.9169±0.0277a	PJW	0.8198±0.0384cd
CYS	0.8966±0.0186ab	SY	0.8028±0.0166cd
DWT	0.8931±0.0207ab	STP	0.7978±0.0172d
LD	0.8812±0.0322ab	XJ	0.7912±0.0282d
LBS	0.8552±0.0100bc	ZJ	0.7164±0.0204e

Table 3 shows the soil pH of the proposed high-standard farmland plot in Fengxiang area. As can be seen from Table 3, the soil pH value in the study area ranges from 8.21 to 8.29, with an average value of 8.23, among which the soil pH value in Zijing Village is the highest, and that in Beidoufang Village is the lowest, with a relatively low value of 0.96%. The soil pH values of Beidoufang village, Luobashi village and Zijing village were significantly different at Duncan's new complex range method ($P<0.05$) level.

Table 3 The soil pH values of areas to be built with high standard farmland in Fengxiang

Village	pH	Village	pH
BDF	8.21±0.0544a	PJW	8.23±0.0287cd
CYS	8.22±0.0330ab	SY	8.24±0.0205cd
DWT	8.22±0.0262ab	STP	8.24±0.0294d
LD	8.22±0.0189ab	XJ	8.24±0.0216d
LBS	8.22±0.0262bc	ZJ	8.29±0.0170e

4. Conclusion

According to this study, the content of sand, silt and clay in the study area ranged from 68.66% to 83.11%, 3.41% to 19.98% and 10.86% to 13.48%, and the soil texture type was mostly silt. The total amount of water-soluble salt in soil ranges from 0.7164 g/kg to 0.9169 g/kg, which

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does not meet the standard of saline soil and is non-saline soil. The pH value of the soil ranges from 8.21 to 8.29, and the acid-base grade is alkaline. Through proper alkali modification, the newly built high-standard farmland can meet the needs of soil texture and nutrients for the growth of food crops.

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